Concurrent Operation of RHIC (Ions or PP) and NSRL

- Review of the switching operations that allow us to run various programs simultaneously.
- Examples of what we have done and can do.
- Complications that have arisen.

Switching Operations

- Pulse-to-Pulse Modulation (PPM)
- Context Switching (PPM on demand)
- Mode Switching (non-PPM)

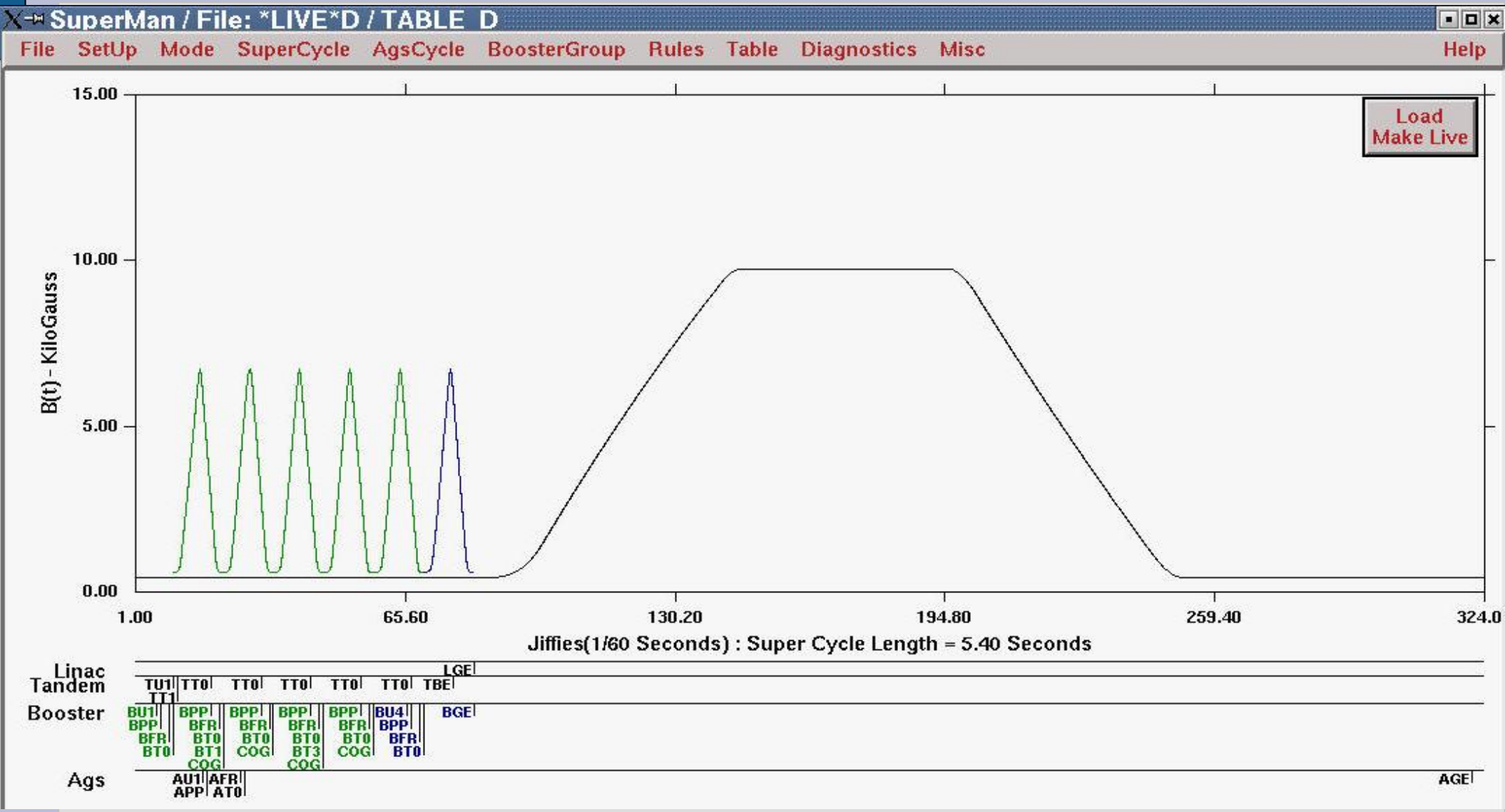
PPM Switching

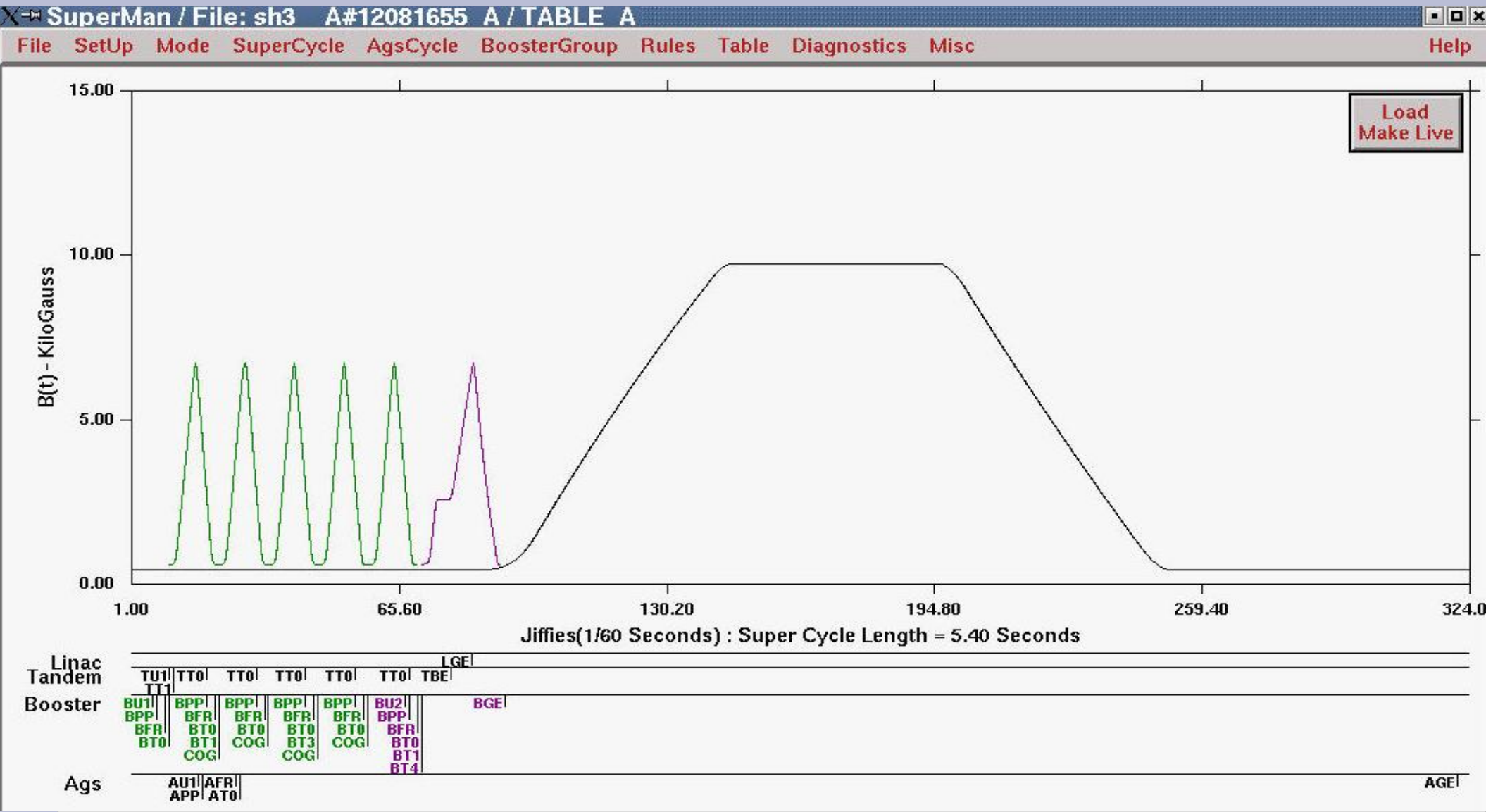
- This is the switching of device setpoints between Booster or AGS magnetic cycles (pulses). The setpoints are thereby modulated on a pulse-to-pulse basis; hence the name “ppm”.
- Four different sets of setpoints are possible for both Booster and AGS. One therefore can have four “Users” of accelerator devices, each user specifying a set of setpoints.

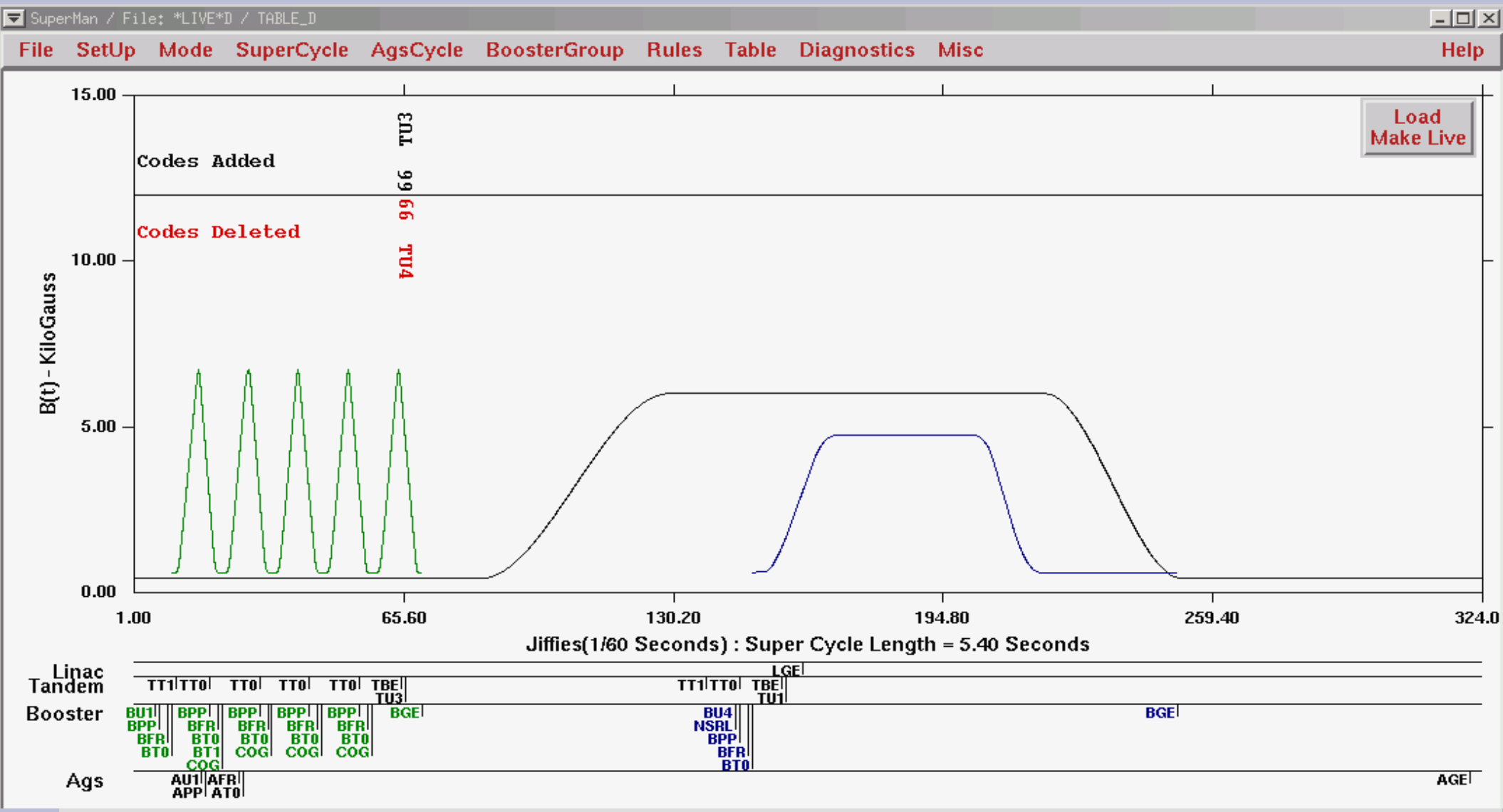
The SuperCycle

- The users need a driver; this is the function of the SuperCycle.
- One can have multiple Booster users on a given supercycle, but only 1 AGS user.
- Each Booster user can have one or more magnetic cycles.
- The AGS user can have just one magnetic cycle.

Examples


SuperMan / File: *LIVE*D / TABLE D
File SetUp Mode SuperCycle AgsCycle BoosterGroup Rules Table Diagnostics Misc Help
Load
Make Live
15.00
10.00
5.00
0.00
B(t) - KiloGauss
1.00
65.60
130.20
194.80
259.40
324.0
Jiffies(1/60 Seconds) : Super Cycle Length = 5.40 Seconds
Linac
Tandem
Booster
Ags
LGE
TU1
TT1
TT0
TBE
BU1
BPP
BFR
BT0
BT1
COG
BT3
BU4
BGE
AU1
APP
AFR
AT0
AGE

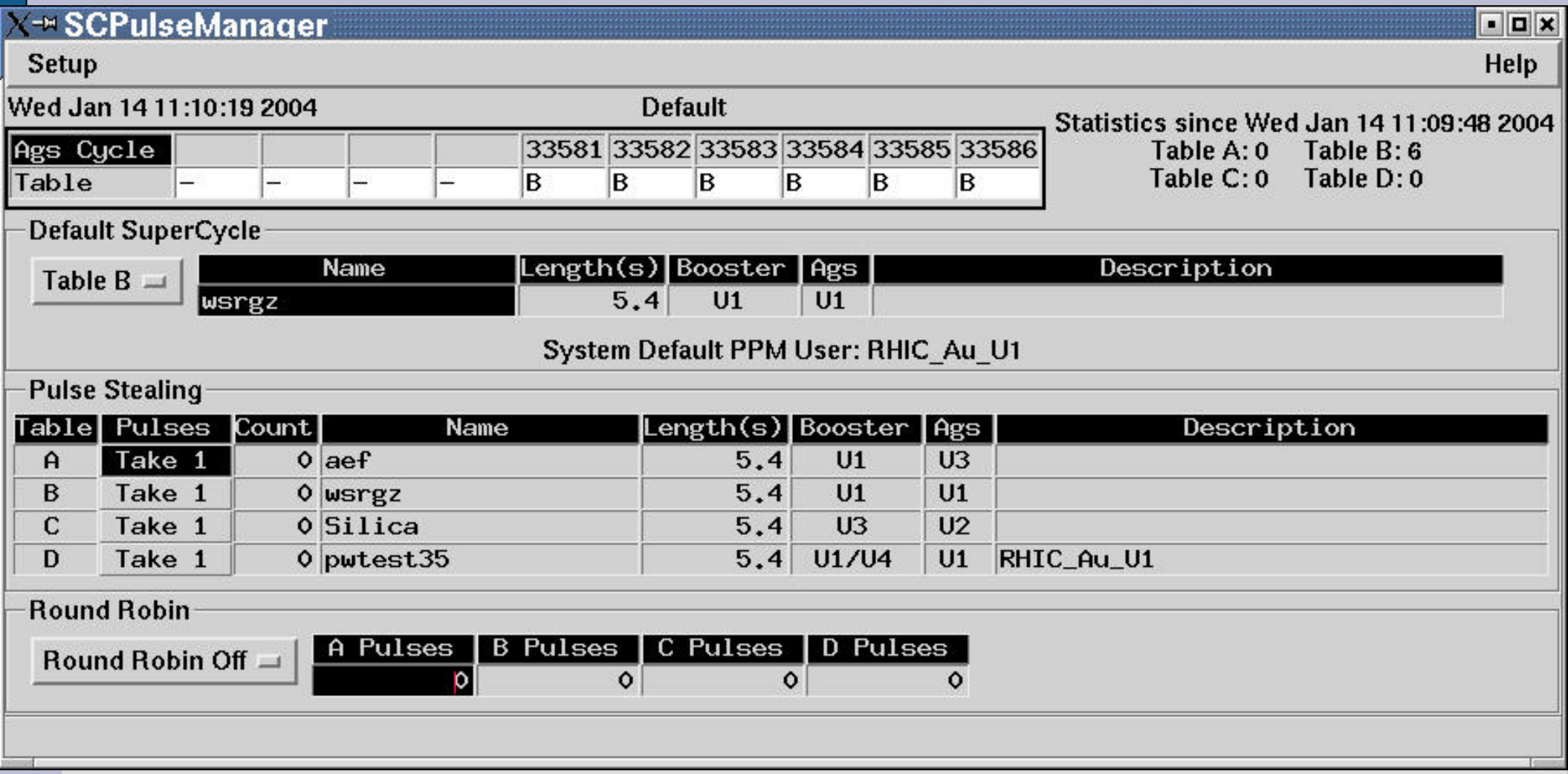

SuperMan / File: sh3 A#12081655 A / TABLE A
File SetUp Mode SuperCycle AgsCycle BoosterGroup Rules Table Diagnostics Misc Help
Load
Make Live
15.00
10.00
5.00
0.00
B(t) - KiloGauss
1.00
65.60
130.20
194.80
259.40
324.0
Jiffies(1/60 Seconds) : Super Cycle Length = 5.40 Seconds
Linac
Tandem
Booster
Ags
TU1
TT1
TT0
TBE
LGE
BU1
BPP
BFR
BT0
BT1
COG
BT3
BU2
BT4
BGE
AU1
APP
AFR
AT0
AGE


SuperMan / File: *LIVE*D / TABLE_D
File SetUp Mode SuperCycle AgsCycle BoosterGroup Rules Table Diagnostics Misc Help
Load
Make Live
Codes Added
Codes Deleted
TU3 99
TU4 99
15.00
10.00
5.00
0.00
B(t) - KiloGauss
1.00
65.60
130.20
194.80
259.40
324.0
Jiffies(1/60 Seconds) : Super Cycle Length = 5.40 Seconds
Linac
Tandem
Booster
Ags
TT1 TT0 TT0 TT0 TT0 TBE TU3
LGE
TT1 TT0 TBE TU1
BU1 BPP BFR BT0
BPP BFR BT0 BT1 COG
BPP BFR BT0 COG
BPP BFR BT0 COG
BPP BFR BT0 COG
BGE
BU4 NSRL BPP BFR BT0
BGE
AU1 APP
AFR AT0
AGE

Context Switching

- Sometimes we want to switch from one supercycle setup to another on demand.
- This is called “Context Switching”, “Pulse Stealing” or “PPM on demand”.
- Different supercycles are stored in tables that can be invoked on demand.
- For commissioning different modes of operation or for regular toggling back and forth between two beam operations programs.

Supercycle Pulse Manager



Mode Switching

- We use mode switching to switch devices that cannot be switched on a pulse-to-pulse basis, such as:
  - BTA and ATR magnets;
  - Booster and BTA stripping foils;
  - AGS Injection Kicker;
  - Tandem and TTB elements;
  - R-line (NSRL) elements;
  - AGS Warm and Cold Snakes.

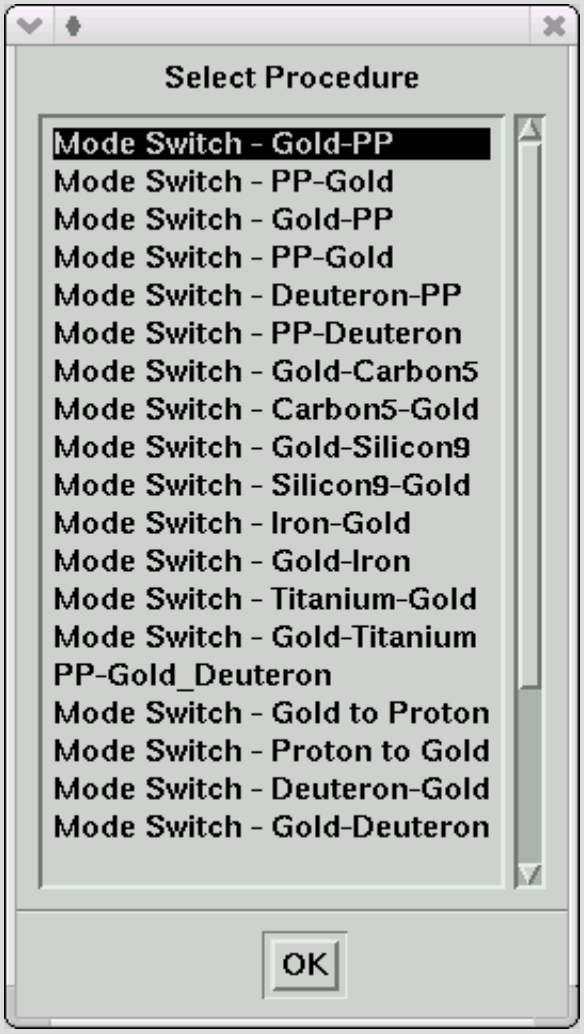
Mode Switching Experience

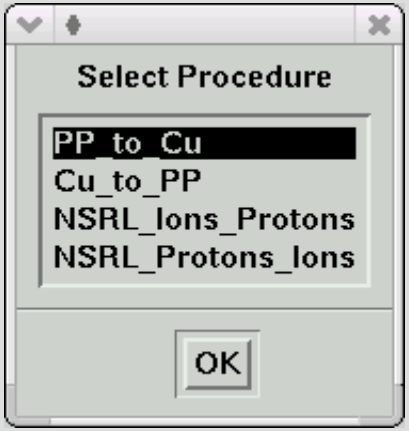
- RHIC Gold <=> AGS Proton SEB
- RHIC Gold <=> Deuterons <=> PP
- RHIC Gold <=> Nsrl Ions
- RHIC Gold <=> AGS PP Setup
- RHIC Copper <=> AGS PP Setup
- RHIC PP <=> AGS Cold Snake Setup
- Nsrl Protons <=> Nsrl Iron (Titanium)

FY04 Program

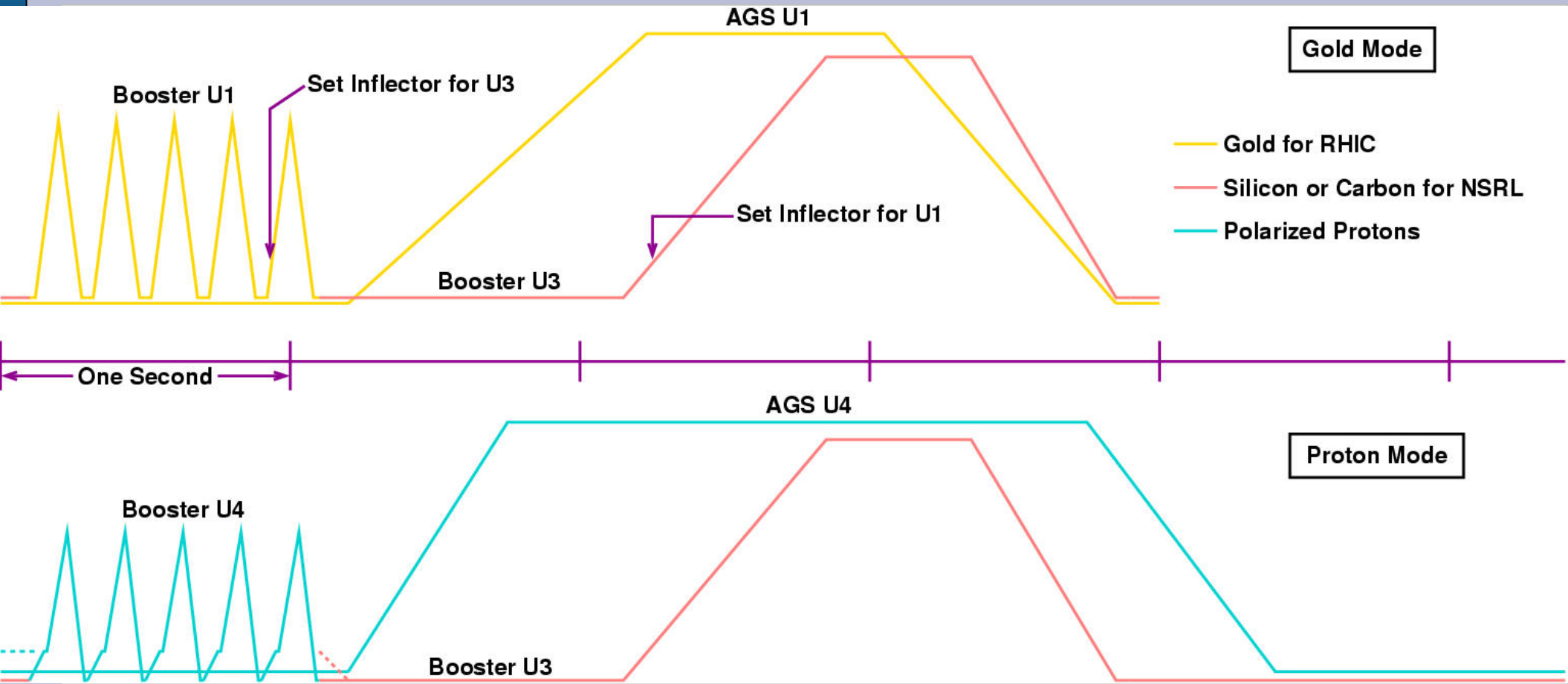
Week no.	Starting Monday	Actually !	Description				
1	1-Dec-2003		5-week RHIC Startup				
2	8-Dec-2003						
3	15-Dec-2003						
4	22-Dec-2003						
5	29-Dec-2003	Dec.31, 2003					
1	5-Jan-2004		14-week RHIC Au-Au run	LINAC turns on			
2	12-Jan-2004						
3	19-Jan-2004						
4	26-Jan-2004						
5	2-Feb-2004						
6	9-Feb-2004						
7	16-Feb-2004						
8	23-Feb-2004						
9	1-Mar-2004						
10	8-Mar-2004			Booster/AGS polarized proton run		NSRL	BLIP
11	15-Mar-2004						
12	22-Mar-2004						
13	29-Mar-2004						
14	5-Apr-2004						
1	12-Apr-2004		5-week polarized proton run				
2	19-Apr-2004						
3	26-Apr-2004						
4	3-May-2004						
5	10-May-2004						
	17-May-2004						
	24-May-2004						
	31-May-2004						
	7-Jun-2004						
	14-Jun-2004						

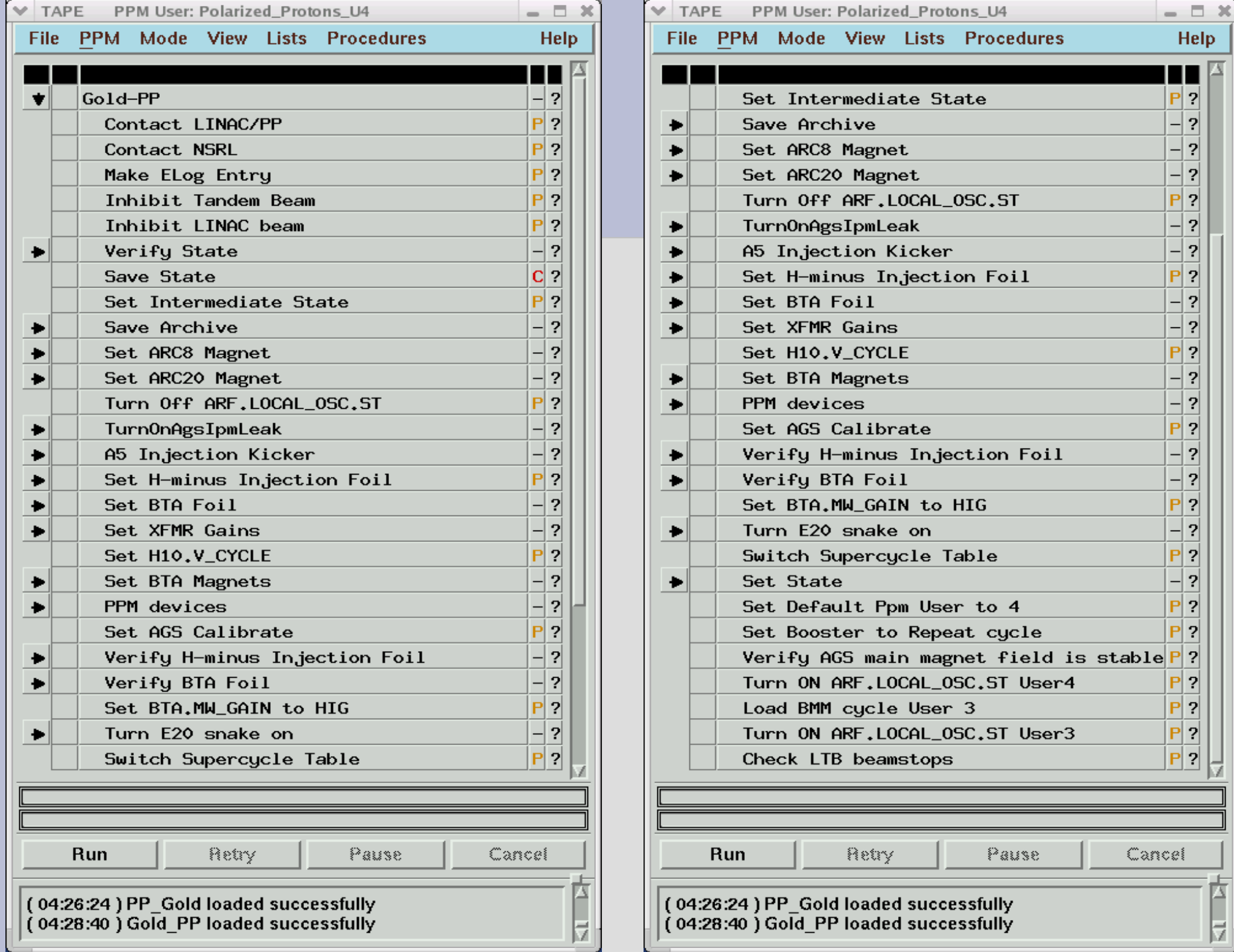
TAPE (Tool for Automated Procedure Execution)

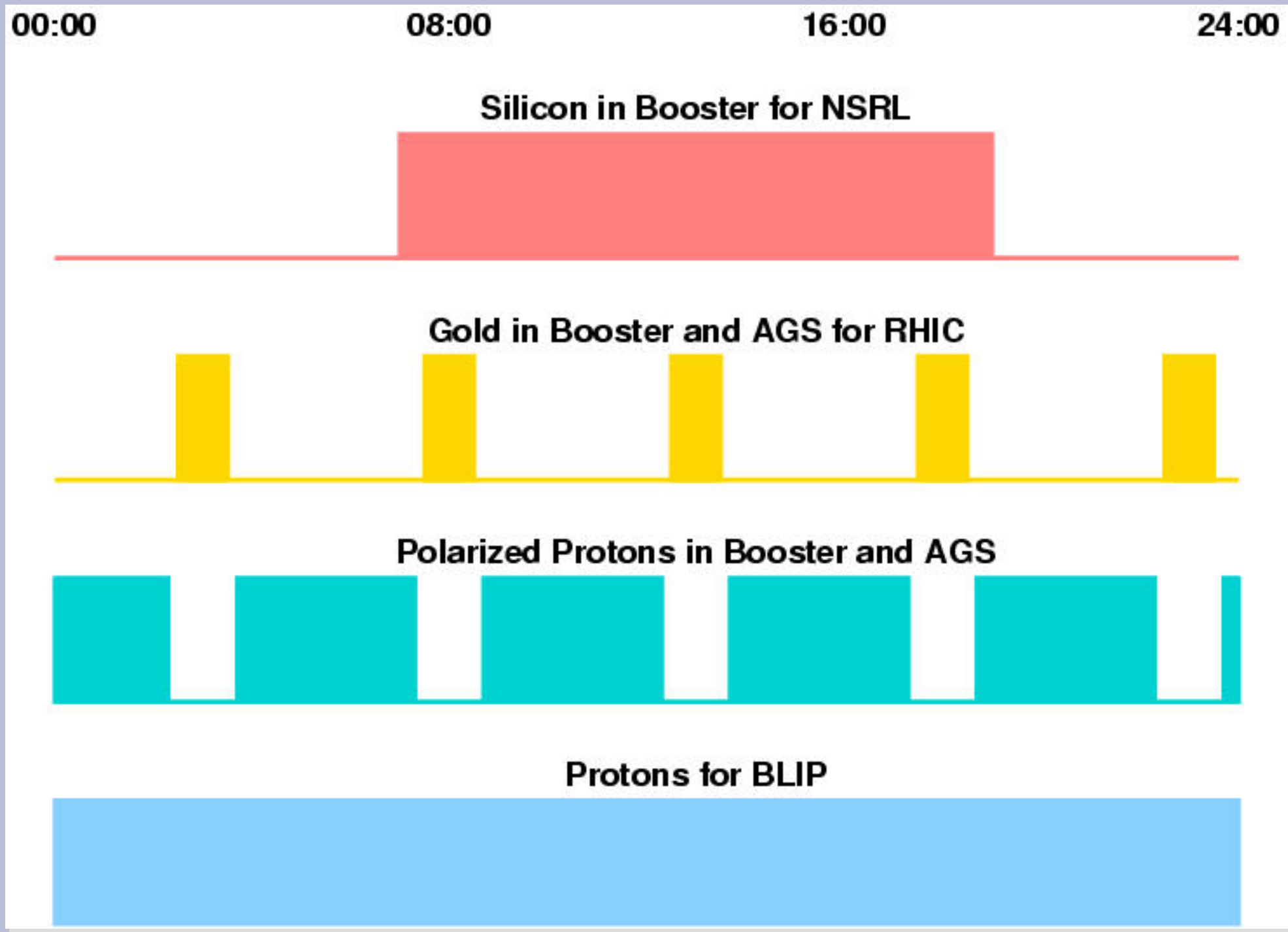


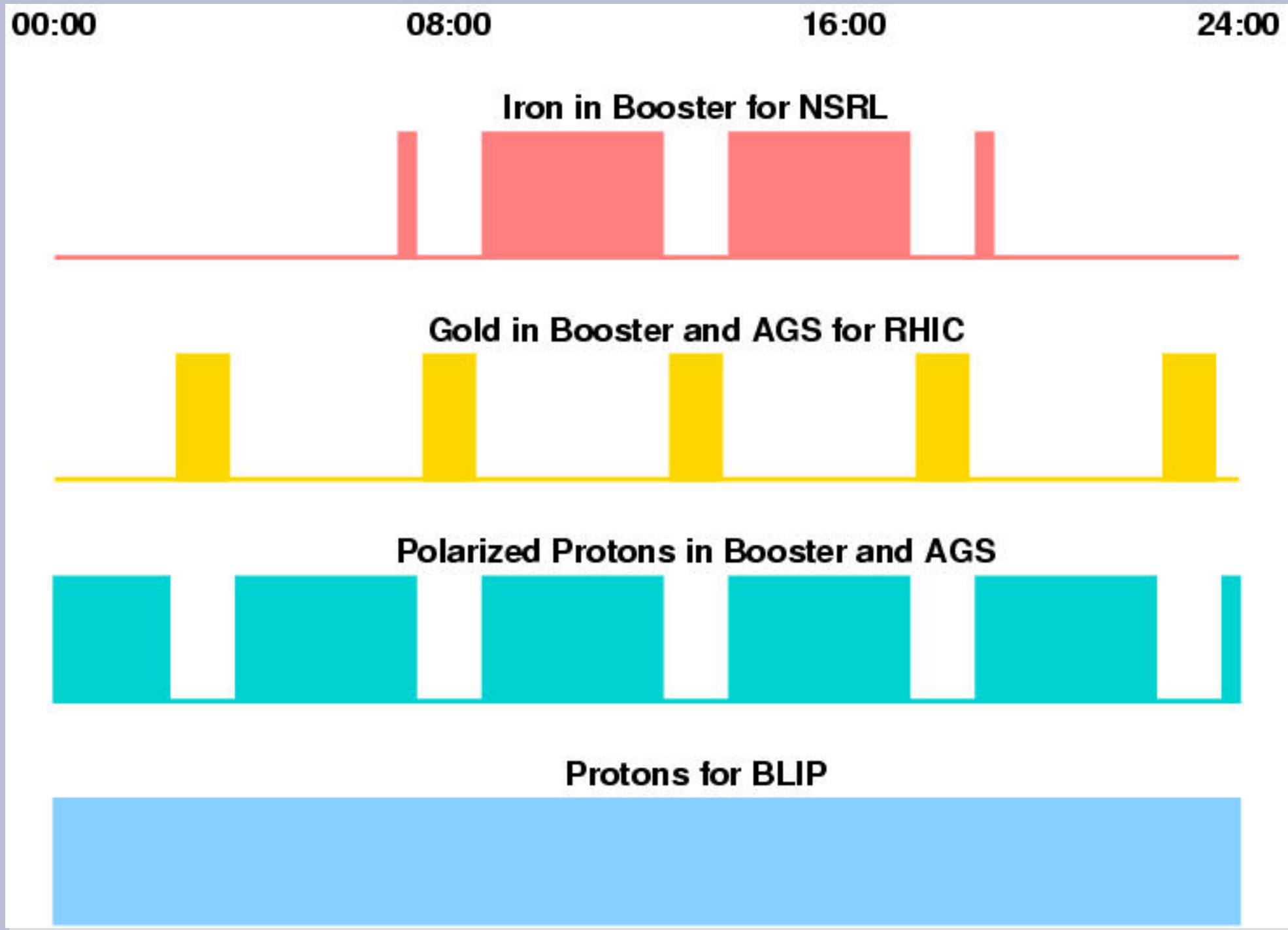


Gold and PP Mode Switch




TAPE PPM User: Polarized_Protons_U4
File PPM Mode View Lists Procedures Help
Gold-PP
Contact LINAC/PP
Contact NSRL
Make ELog Entry
Inhibit Tandem Beam
Inhibit LINAC beam
Verify State
Save State
Set Intermediate State
Save Archive
Set ARC8 Magnet
Set ARC20 Magnet
Turn Off ARF.LOCAL_OSC.ST
TurnOnAgsIpmLeak
A5 Injection Kicker
Set H-minus Injection Foil
Set BTA Foil
Set XFMR Gains
Set H10.V_CYCLE
Set BTA Magnets
PPM devices
Set AGS Calibrate
Verify H-minus Injection Foil
Verify BTA Foil
Set BTA.MW_GAIN to HIG
Turn E20 snake on
Switch Supercycle Table
Run
Retry
Pause
Cancel
(04:26:24) PP_Gold loaded successfully
(04:28:40) Gold_PP loaded successfully
TAPE PPM User: Polarized_Protons_U4
File PPM Mode View Lists Procedures Help
Set Intermediate State
Save Archive
Set ARC8 Magnet
Set ARC20 Magnet
Turn Off ARF.LOCAL_OSC.ST
TurnOnAgsIpmLeak
A5 Injection Kicker
Set H-minus Injection Foil
Set BTA Foil
Set XFMR Gains
Set H10.V_CYCLE
Set BTA Magnets
PPM devices
Set AGS Calibrate
Verify H-minus Injection Foil
Verify BTA Foil
Set BTA.MW_GAIN to HIG
Turn E20 snake on
Switch Supercycle Table
Set State
Set Default Ppm User to 4
Set Booster to Repeat cycle
Verify AGS main magnet field is stable
Turn ON ARF.LOCAL_OSC.ST User4
Load BMM cycle User 3
Turn ON ARF.LOCAL_OSC.ST User3
Check LTB beamstops
Run
Retry
Pause
Cancel
(04:26:24) PP_Gold loaded successfully
(04:28:40) Gold_PP loaded successfully

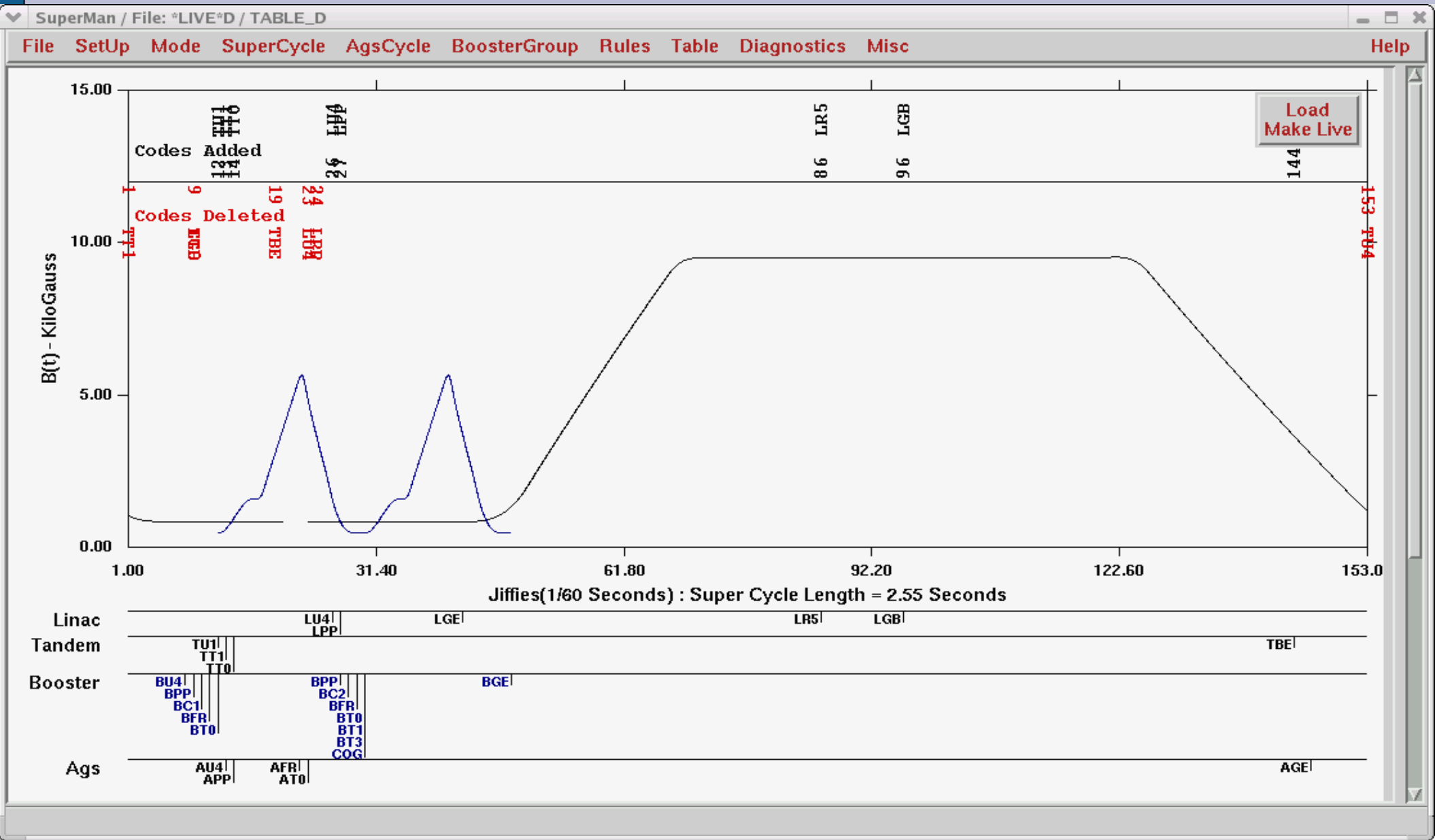

00:00
08:00
16:00
24:00
Silicon in Booster for NSRL
Gold in Booster and AGS for RHIC
Polarized Protons in Booster and AGS
Protons for BLIP


00:00
08:00
16:00
24:00
Iron in Booster for NSRL
Gold in Booster and AGS for RHIC
Polarized Protons in Booster and AGS
Protons for BLIP

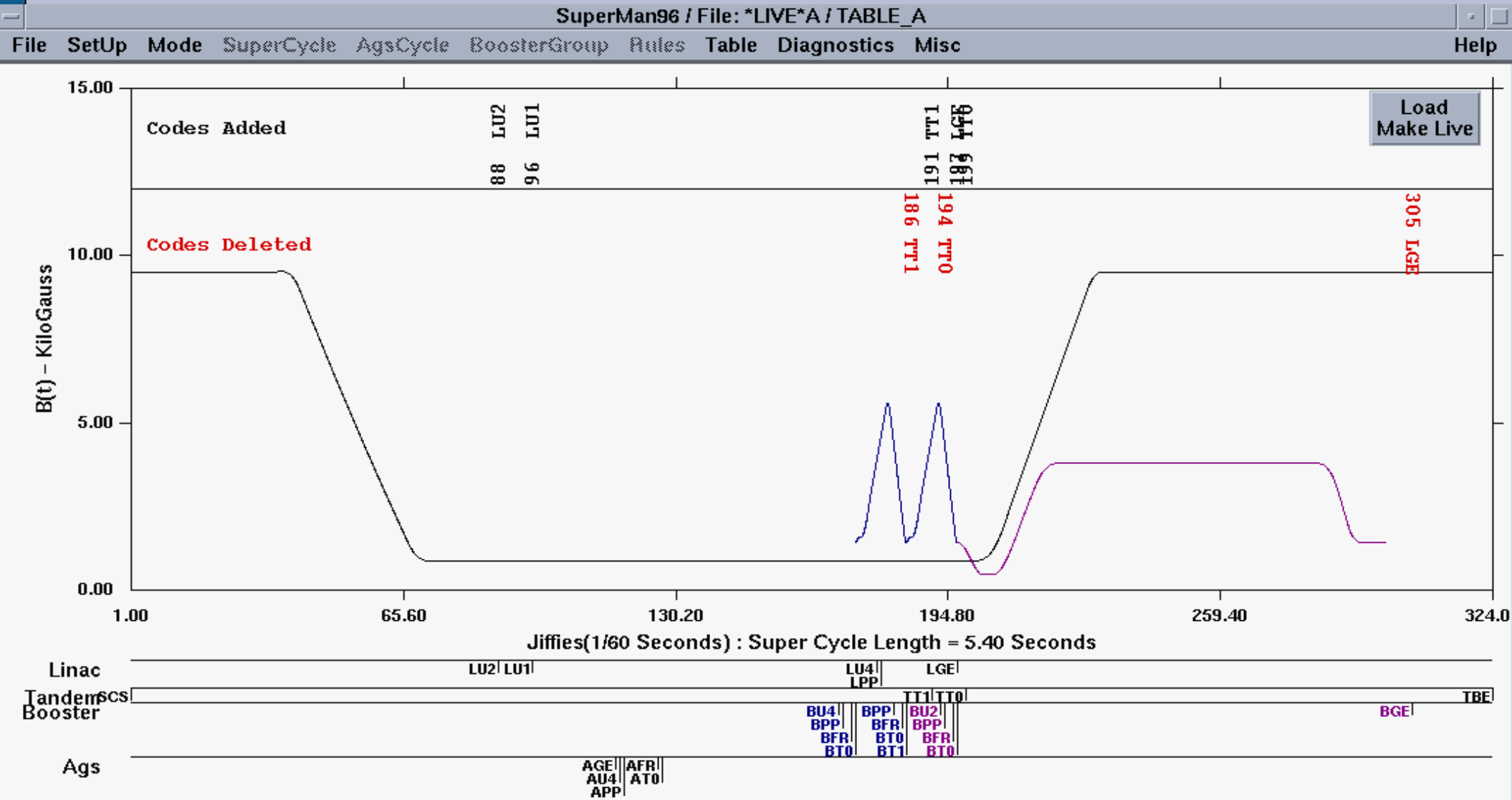
FY05: RHIC (Copper and PP)and NSRL (Ions and PP)

- Copper for RHIC <=> PP for AGS.
- PP for RHIC <=> AGS Cold Snake development.
- PPM: NSRL & RHIC PP.
- Proton-Titanium mode switch for NSRL.

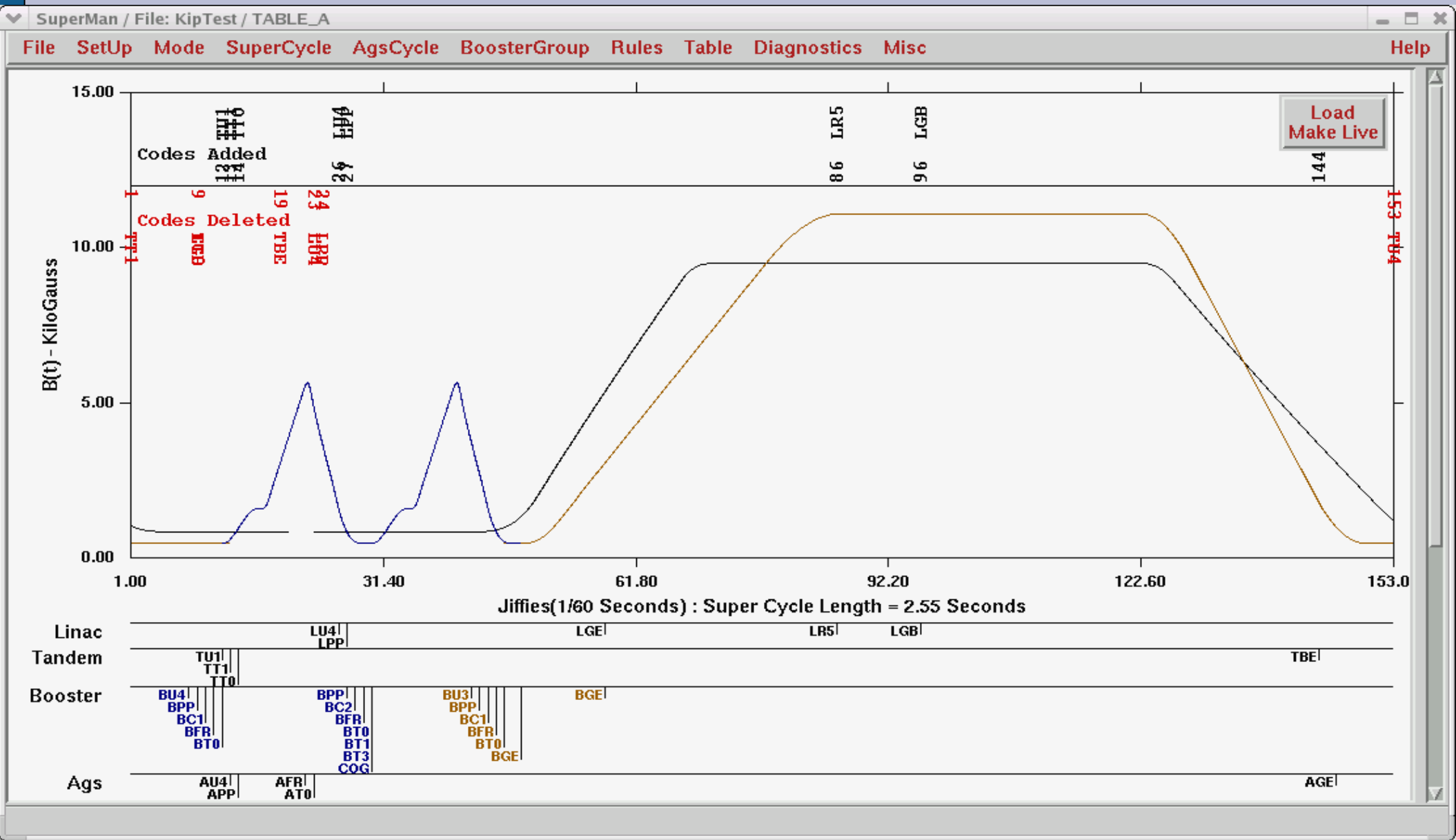
PP to AGS for RHIC



Complication:
Booster Dwell Field Matching

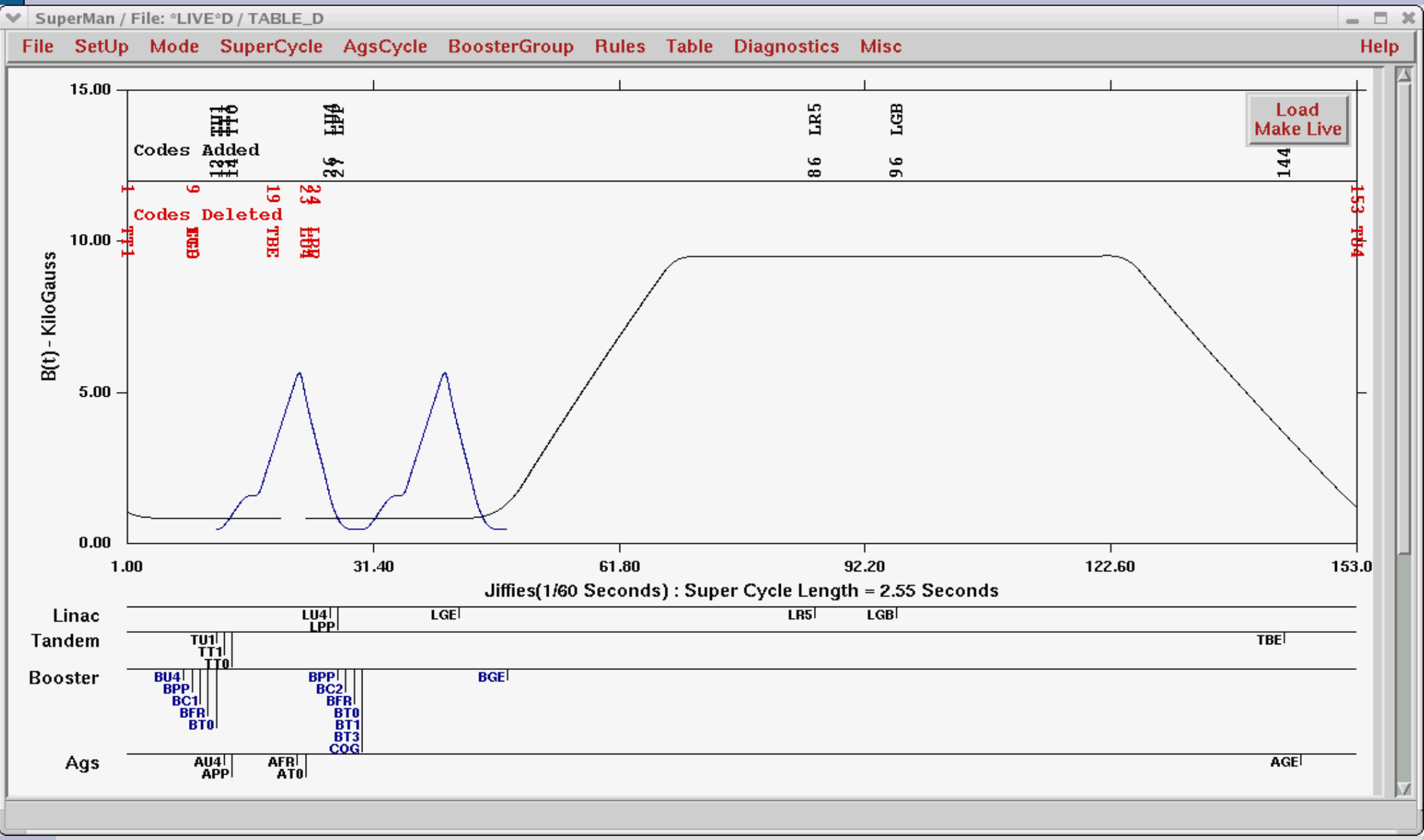


Possible PP & NSRL PPM, but power too high for PS:

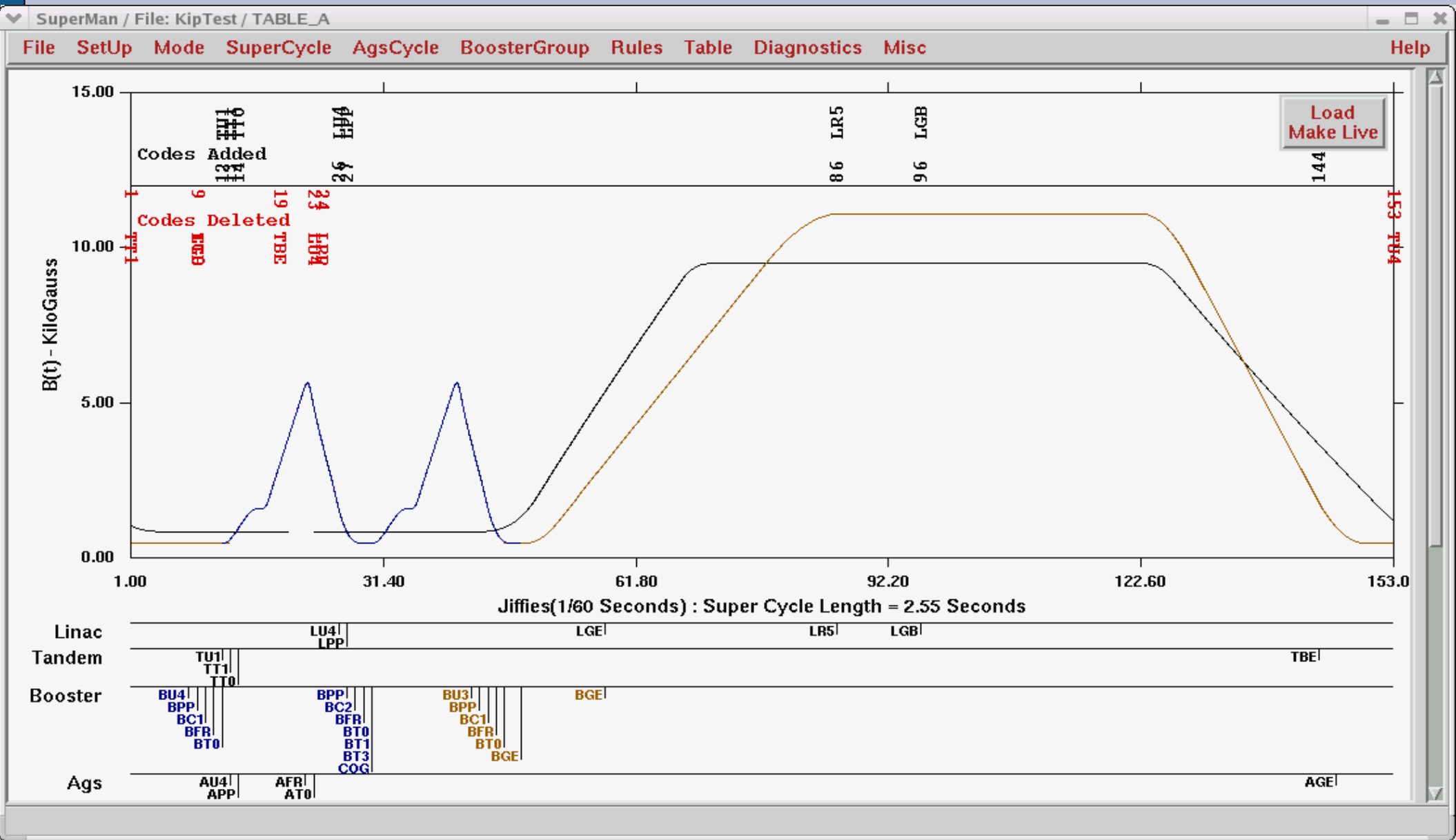


So...use a longer supercycle for PP and NSRL PPM:

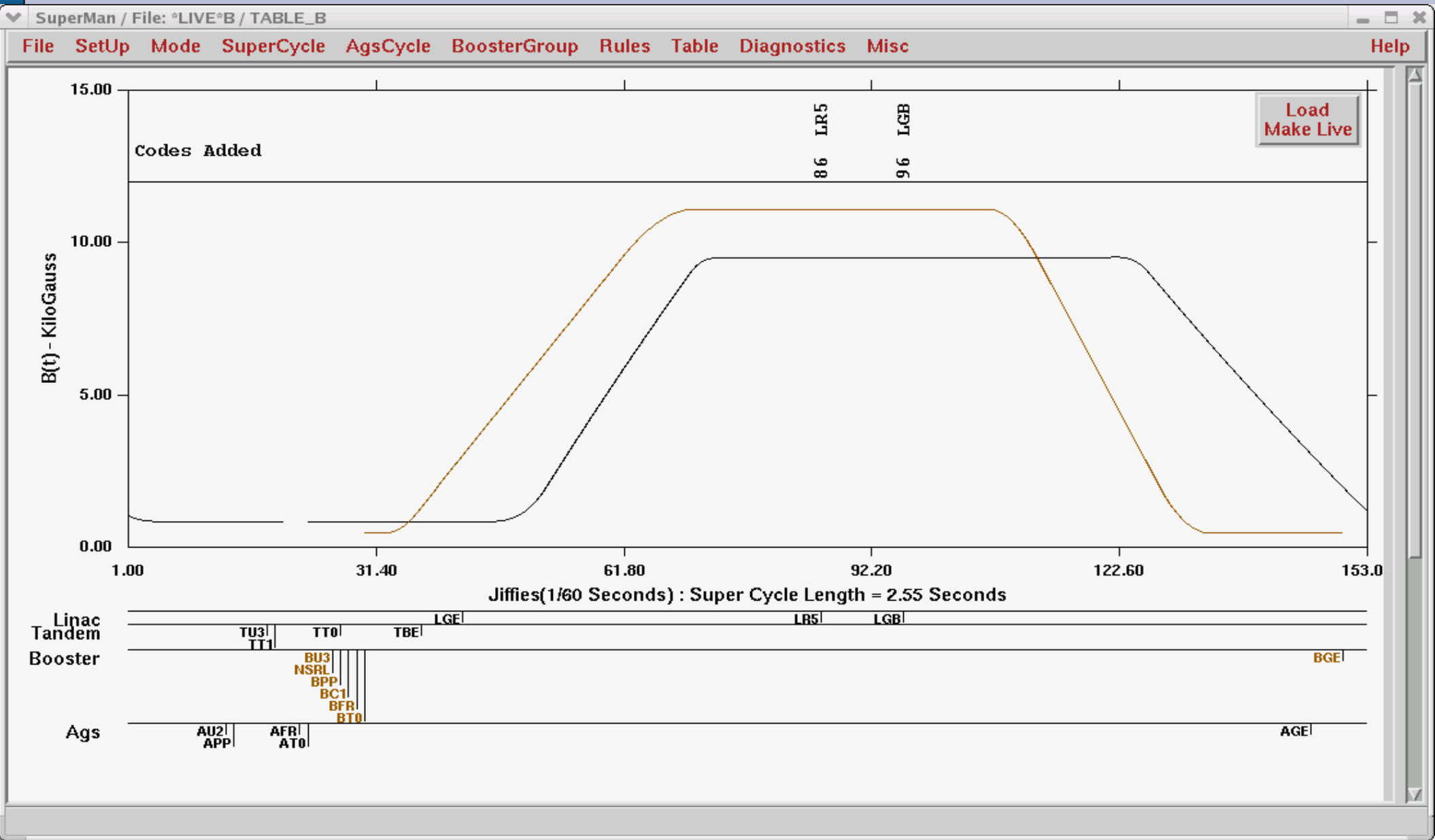
Or Toggle between modes:



and:


SuperMan / File: KipTest / TABLE_A
File SetUp Mode SuperCycle AgsCycle BoosterGroup Rules Table Diagnostics Misc Help
Load
Make Live
Codes Added
Codes Deleted
B(t) - KiloGauss
15.00
10.00
5.00
0.00
1.00
31.40
61.80
92.20
122.60
153.0
Jiffies(1/60 Seconds) : Super Cycle Length = 2.55 Seconds
Linac
Tandem
Booster
Ags
LU4
LPP
LGE
LR5
LGB
TBE
TU1
TT1
TT0
BU4
BPP
BC1
BFR
BT0
BPP
BC2
BFR
BT0
BT1
BT3
COG
BU3
BPP
BC1
BFR
BT0
BGE
BGE
AU4
APP
AFR
AT0
AGE

Or no Booster cycles for AGS with the NSRL cycle:



Complications:

- Required spin resonance correction depends on AGS repetition period.
- If the NSRL cycle is taking PP, the accounting of spin up and down for AGS requires some care.

Other Complications:

- Linac timing is very sensitive to the placement of supercycle events.
- Sinusoidal timing of HEBT dipole for 200 MeV polarimeter requires careful placement of supercycle events.
- Setting of BM2 between source and RFQ depends on whether NSRL is taking PP or not.
- NSRL extraction bump affects BTA trajectory for PP to RHIC.